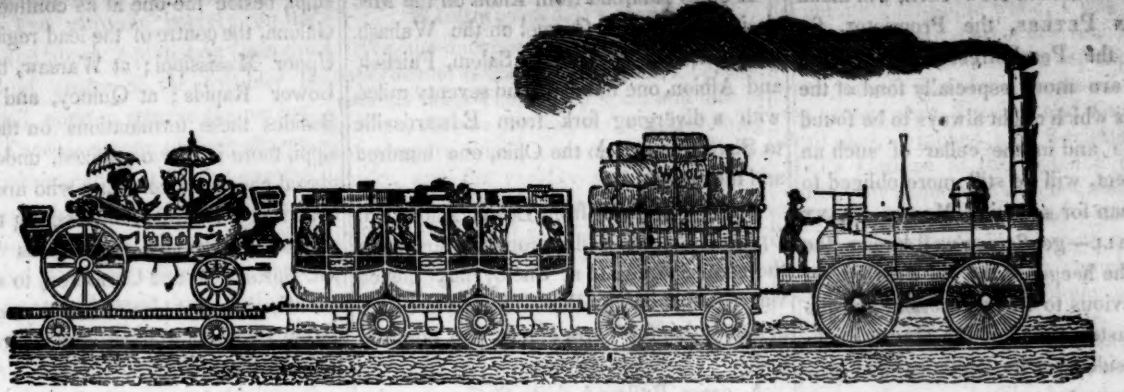

AMERICAN RAILROAD JOURNAL, AND ADVOCATE OF INTERNAL IMPROVEMENTS.

PUBLISHED WEEKLY, AT NO. 30 WALL STREET, NEW-YORK, AT FIVE DOLLARS PER ANNUM, PAYABLE IN ADVANCE.

D. K MINOR, and GEORGE C. SCHAEFFER, } EDITORS AND PRORIETORS.]

SATURDAY, APRIL 1, 1837. VOLUME VI—No 13.

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AMERICAN RAILROAD JOURNAL.

NEW-YORK, APRIL 1, 1837.

REMOVAL.—The Office of the RAILROAD JOURNAL, NEW-YORK FARMER, and MECHANIC'S MAGAZINE, is removed to No. 30 WALL-STREET, *basement story*, one door from William street, and *opposite the Bank of America*.

☞ For List of Subscribers that have paid see page 207.

☞ It will not do, these hard times for money, to be too modest. The *Paper Maker* must be paid, the *Engraver*, the *Ink Maker*, and the *Printer* must be paid,—then why not Pay the Publishers and the Editors the *current year* and all *arrearages* for the Journal? *It must be done.*—PLEASE REMIT BY MAIL.

WABASH AND ERIE CANAL.

NOTICE TO CONTRACTORS.—Sealed proposal will be received at the town of MAUMEE, in Lucas county, Ohio, *on the 15th day of May next*, for the construction of so much of the line of the Wabash and Erie Canal as lies between the head of the rapids of the Maumee River and the eastern termination of said canal, near the town of Mahatten, at the head of the Maumee Bay.

The length of the line offered for contract is about thirty miles, and embraces a large amount of embankment, much heavy river bluff excavation, a quantity of rock, a number of stone culverts, and 12 to 15 cut stone locks.

Thirty miles of the line, in addition to the above extending from the head of the rapids to the town of Defiance, will also be prepared, and offered for contract at the same time, should the number of applicants for contracts justify it.

Plans and specifications will be exhibited, and necessary information given, in relation to the work, after the tenth of May.

Bidders who are unknown to the acting Commissioner, as contractors, will be expected to accompany ther proposals with recommendations of a substantial and unquestionable character.

LEANDER RANSOM.
Acting Commissioner.

Office of the Board of Public Works, }
Columbus, Ohio, Feb. 28, 1837, }

13—2t

PEARL-STREET HOUSE.—Who, of the thousands of Merchants that have been in the habit of visiting New-York for the last *ten* years, does not recollect the "PEARL-STREET HOUSE?" It was once the "*Merchants' House;*" but during the *past* year its old inhabitants could scarcely point out its site, so complete was its destruction by "the great conflagration." The *Pearl-street House* has, however, again reared its head, far above the surrounding buildings, and presents an external appearance, at once noble and inviting; an appearance which will not lead the visitor to dissappointment, on an *interior* examination.—This House, or Hotel, has its principal front on *Pearl*, and extends through to *Water*-street; is six stories on Pearl and seven on Water-street. Its principal entrance is by an easy flight of stairs to the *Exchange* room, which is about 50 feet square, with marble floor, and well lighted in front. In the rear of this, on one side, is the Dining room, which will accommodate over 350 persons, extending through to, and along Water-street—with *broad folding doors*, opening from the Exchange room, and several others communicating with the principal hall. There are one hundred and eighty Lodging rooms, well furnished—the beds can hardly fail to please, as each has a feather, a straw bed, and hair mattrass.

There is not another house in this city, probably not in the Union, except the Astor House, with as many conveniences as the Pearl-street House. There is one of Avery's *Rotary Steam* Engines and Boiler, which pumps all the water required in the establishment, and throws it from Pearl-street to the 7th story on Water-street. It furnishes steam to the *Kitchen*, to do all the *boiling*—and heats all the water required to do the *washing* of the house, and also for the Bathing rooms, of which there are a sufficient number to accommodate the guests of the house. On repeating our visit to this immense establishment, which has been completed, furnished, and occupied in less than nine months from its commencement, we come to the conclusion, that there is more room, and far more extensive accommodation, on the same space of ground, than can be found elsewhere in the United States. It is easy of access, and what is of great consequence to *strangers*, in case of *alarm* by fire, there can be no difficulty in finding the way *out*, as there are two principal stairways from the *streets* to the *roof*.

Those who are fond of a quiet, well furnished, and well arranged *home*, while at-

tending to business in New-York, will thank Alderman Peters, the Proprietor, for rebuilding the Pearl-street House; and those who are more especially fond of the good things which ought always to be found on the table and in the cellar of such an establishment, will be still more obliged to the Alderman for selecting Messrs. Flint and Whitall—gentlemen well known, the former as the keeper of the *old* Pearl-street House, previous to its destruction, and the latter as master of one of the Havre Packets—to preside over its destinies and provide for its guests.

On the 20th ult., the doors were opened to receive company, and thousands of our citizens paid their respects, not only to the gentlemen who guide its destinies, but also to the good cheer with which the tables were abundantly supplied; and we have now only to say to those who desire all the comforts which are to be enjoyed at any Hotel go and see for yourselves.

RAILROADS AND CANALS IN ILLINOIS.

We ask for the following communication, an attentive perusal. It illustrates, with great force and truth, the pervading spirit of the age; and it must surely satisfy those who are still incredulous as to the high destinies of that young State, that Illinois in a few years will be second, and but for her unrivalled *city*—only second, to the State of New York.

We are obliged to "The Far West" for the interest he expresses in the success of this Journal—and we are disposed to hold him to his very liberal offer to "keep us informed of the prospects of the public works in the State." We hope to hear often from him especially in relation to the probable connection of the public works in Illinois with other great works in other States.

GRAND SYSTEM OF INTERNAL IMPROVEMENT IN ILLINOIS. The Legislature of Illinois has recently adjourned, after passing an act to *establish and maintain* a general system of Internal Improvement. A Board of Commissioners of Public Works is appointed, who are authorized and required to adopt such measures as may be necessary for constructing and completing the following works:—

A Railroad from Cairo, at or near the the confluence of the Ohio and Mississipp rivers, to Galena on the Upper Mississippi to pass through Vandalia, Shelbyville, Decatur and Bloomington, intersect the southern termination of the Illinois and Michigan canal, and from thence through Savanna to Galena. Ranging through the centre of the State its entire length, five hundred miles.

A cross Railroad from Alton on the Mississippi to Mount Carmel on the Wabash, via. Edwardsville, Carlyle, Salem, Fairfield and Albion, one hundred and seventy miles, with a diverging fork from Edwardsville to Shawneetown on the Ohio, one hundred and fifty miles.

A cross Railroad from Lower Alton, via. Upper Alton and Hillsborough, intersecting the central Railroad at Shelbyville, thence via. Charleston and Paris, to the State line in a direction for Terra Haute, two hundred miles.

A cross Railroad from Quincy on the Mississippi, to the State line, near La Fayette, Indiana, via. Columbus, Clayton, Mount Sterling, Meredosia, Jacksonville, Springfield, Decatur, Sydney and Danville, two hundred and fifty miles.

A Railroad from Peoria on the Illinois river to Warsaw on the Mississippi, through Canton, Macomb and Carthage, one hundred and twenty miles.

A Railroad from Bloomington, a point on the great central Railroad to meet the Railroad from Warsaw at Peoria, and a point from the same at Mackinaw town via. Tremont, to strike the Illinois river at Pekin, seventy-five miles.

A Railroad from Belleville via. Lebanon to intersect the Alton and Mount Carmel Railroad, twenty-five miles.

Specific appropriations are made for each route, besides which, two hundred and fifty thousand dollars are appropriated for the improvement of the great western mail route from Vincennes on the Wabash to St. Louis:—and six hundred thousand to improve the navigation of the Great and Little Wabash, the Illinois, the Kaskaskia and Rock rivers, including a portion divided among certain counties to be used at their own discretion.

It will be seen that beside the great central Railroad, which touches the Missisippi at Galena, and of its confluence with the Ohio, there are four Railroads which run entirely across the State, besides one nearly two hundred miles in extent which intersects the Central Railroad, striking the Illinois river at two points. There are three terminations at the Indiana line; one, near La Fayette, which opens a line of communication with New York, by the Maumee and Erie canal; one near Terra Haute, a point of the National road, and of intended communication with the Central canal of Indiana, and with Evansville, by a Railroad, and one at Mount Carmel, below the rapids of the Wabash.

There are the terminations on the Ohio; one at Shawneetown, and one at or near the mouth of the river.

There are four terminations on the Mississippi, beside the one at its confluence; viz. Galena, the centre of the lead region on the Upper Mississippi; at Warsaw, below the Lower Rapids; at Quincy, and at Alton. Besides these terminations on the Mississippi, there is now organized, under a very liberal charter, a company who are about to construct a Railroad, intersecting the Quincy and La Fayette main cross Railroad, via. Springfield and Carrollton, to strike the the Mississippi at Grafton, at the confluence of the Illinois and Mississippi rivers, a most important point.

It should be remarked that less than twenty-five miles would connect the great Central Railroad, with the Ohio river at a point above the mouth of Cumberland river from whence a route has been projected through Princeton and Hopkinsville in Kentucky, and Clarksville Tennessee to Nashville, a distance of one hundred and thirty miles only, to effect the most important junction with the Nashville and New-Orleans Railroad. We have thus about one hundred and fifty miles of Railroad, and to provide for to *open a direct Railroad communication between New Orleans and the Upper Mississippi and the Great Lakes!* A distance of nearly twelve hundred miles, through the heart of the most fertile region on the face of the globe.

To the prudent calculators of the North, the magnificent enterprise of the young State of Illinois may seem premature or extravagant. We beg them however to reflect that we have a territory equal to that of the State of New-York, the *whole of which*, is of *extraordinary fertility*. That the enhanced value of the land in the immediate vicinity of the projected Railroads, will pay their cost *four times over*. That our population, not only in numbers, but in wealth, enterprise and intelligence, is rapidly increasing; and, what is a more important consideration perhaps than all others, such improvements are in accordance with the spirit of the age, and *our whole people call for them.*

The Great West.

COCHRAN'S MANY-CHAMBERED GUN.

We always take pleasure in speaking of important inventions, even though they may not tend *directly* to the construction of Railroads or Canals—and therefore we give the following testimonials of the value of Mr. Cochran's improvement in *fire-arms*, with a drawing and concise description of the improvement.

The *chambers*, or receptacles for the charge, are in the periphery of a cylinder of about 4 inches in diameter, and ⅞ths of an inch thick, which revolves horizontally on a pivot, bringing each chamber alter

nately in a line with the barrel; on the under side, and about equidistant from the periphery, and centre of the cylinder is placed a small cone to receive the percussion cap. There is a cone to each charge, having a communication with the powder. When the cylinder is charged,—each having *nine* charges,—the caps are put upon the cones, and then the cylinder is put in its place and secured there by a spring.—When in its place, each chamber, or charge, points in a different direction, and each cap is perfectly protected from explosion, except the one communicating with the chamber in line with the barrel, and after discharging which, no further explosion can take place without moving a spring, which permits the cylinder to make the *one-ninth* of a revolution, thereby bringing another chamber, or charge, in line with the barrel. A person familiar with the use of this gun, having *extra* cylinders in his belt, can easily make *thirty shots in a minute*; as he would only remove it from his face *three* times, to make 36 shots.

The great facility with which it can be discharged, is not, as will be perceived, on reading Capt. Gordon's Letter, its highest recommendation. The *certainty* of explosion, even after long exposure in damp weather, is of the first importance; a quality which it appears to possess in an eminent degree.

The accompanying drawings show the positions of the cylinder in which is represented the chambers and the cones for the caps.

If further evidence, than the annexed letters from gentlemen every way qualified to give a correct opinion, is required, it can be furnished, by actual demonstration, to those who will call on Mr. Cochran, or Messrs. Richards & Richardson, of this city, who are the Agents of the Company engaged in the manufacture of the article.

☞ A specimen of this beautiful article may be seen at this office—where orders will be received for *Rifles* or *Pistols*.

I have examined, and seen fired the ingenious invention of Mr. John Cochran's many-chambered gun, and have no hesitation in saying, it combines simplicity, neatness, and at the same time, great despatch; and for all the uses of warfare, should approve of it highly.

ANDREW JACKSON.

Washington, Jan., 1837.

I cheerfully unite in the above testimonial, of Mr. J. W. Cochran's gun.

ANDREW JACKSON, JR.

WASHINGTON CITY, Jan., 1837.

We, the undersigned, have witnessed the experiments made by Mr. John Cochran, with his many-chambered gun, and are of opinion, that we have never seen any thing to compare with it; as to its simplicity, safety, and the rapidity and certainty of its firing; it can be fired thirty times in a minute, with great effect; it is in our opinion, one of the most formidable weapons ever invented.

D. S. CLINCH,
G. J. DRANE, U. S. Army,
WM. P. DUVAL,
WM. COST JOHNSON,
S. WARRINGTON,
SAM'L. C. REID,
CH. G. RIDGELY.

WASHINGTON, Nov. 21, 1836.

COLONEL,—The enclosed report of Lieutenant Scott, which I have the honor to submit, fully confirms the high estimate I had formed of Mr. Cochran's gun, from the experiments instituted by me, on Saturday, in conformity with your instructions.

Under my supervision, the gun was loaded and discharged five hundred times; the results proving its great accuracy, safety, and facility of loading and firing. My attention was particularly called to the apparent danger of ignition, from the contiguity of the charges. But, from the experiments freely made by Mr. Cochran, by placing loose powder in the chambers over the balls, and around the caps, I am convinced that my apprehensions were unfounded.

I do not hesitate to say, that with my closest scrutiny, I could not discover any objections to Mr. Cochran's invention. It will be well to remark, that the gun was discharged in all, one thousand and eight times, without being cleaned, and without missing fire.

The flattened balls accompanying this, were fired through an inch plank against a brick wall, at a distance of 150 yards.

I am, Sir, very respectfully,
Your Obe't. Ser't.
(Signed) GEO. D. RAMSAY.
Capt. of Ordnance.

COL. T. BOMFORD, U. S. Ordnance.

For Mr. Cochran, with the compliments of GEO. D. RAMSAY.

WASHINGTON ARSENAL, Nov. 22, 1836.

SIR,—Having been present at the test of the gun with revolving Cylinders, invented by you, and being a witness to the many experiments, which were made on Saturday, the 19th inst., at this place, I can but attempt to express the great satisfaction it afforded me, to see the following successful trials made by you:

Firstly, As a smooth-bored gun, in regard to the accuracy with which it shoots a ball, I must say that nothing of the kind, that has heretofore come under my observation, can be compared with it; for at a distance of fifty yards, the size of a dollar was struck three times in succession.

Secondly, When the comparison (or rather contrast) was made between your gun and Hall's Carbine, as to the depth of penetration into pine wood, I was most astonished to see the great difference between the two: At the distance of fifty yards, your gun, the first shot, penetrated 4 inches, the second shot, 3 inches and 8-tenths, the third shot, 3 inches and 8-tenths; whilst Hall's Carbine at the distance of fifteen yards, only penetrated 2 inches and 8-tenths.

Thirdly, As to the speed with which it was fired, while Hall's Carbine could only be loaded once, your Gun completely discharged its Cylinder containing nine charges, in the space of six seconds.

Fourthly, As to the certainty of discharge, in firing 1008 charges, not one cap failed, and when double shotted, and fired, no recoil was perceptible.

In fact, your gun, for simplicity, accuracy, and certainty, together with its other inestimable qualities, is, in my opinion, beyond improvement, and may be called a most complete fire-arm.

With very great respect,
I am, Sir,&c.,
JOHN M. ST. JOHN,
Master Armorer, &c., Washington Arsenal.
To JOHN COCHRAN, Esq.,
Brown's Hotel, Washington City.

The piece was fired this morning 500 times, making in all 1008. It is in the same order it was previous to the discharging it. Water was put into the chambers, and left for one hour and ten minutes.—Afterwards, it was discharged in the same manner as the others, without the least difficulty. It fires with great accuracy. I tried it with Hall's carbine, both being loaded, the firing was commenced, during the discharging of the nine chambers, the carbine could only be loaded once, not a cap missed. At the distance of 150 yards, charge 10 grains of powder, the ball perforated an inch pine board, and was flattened against the brick wall. For simplicity, it surpasses any thing of the kind I have yet seen; and as a fire-arm, its qualities can be summed up in three words: It is perfect.

J. B. SCOTT, 1st. Lieut. 4th Infantry.
Washington Arsenal, Nov. 20, 1836.

Mr. Cochran fired the nine chambers in *six seconds*.

J. B. SCOTT, 1st. Lieut. 4th Infantry.

COCHRAN'S GUN TESTED IN A BATTLE WITH THE SEMINOLES, IN FLORIDA, BY CAPTAIN GORDON.

NEW-YORK, March 17, 1837.

SIR,—Having had very ample opportunities of testing the very great superiority of your "Many Chambered" gun, it affords me great pleasure to state, for the public information, that I consider it far superior to any other now in use. Its peculiar adaptation to the purposes of war, gives it just and strong claims to the patronage of the General Government. I do not hesitate to declare it as my firm and decided opinion, that one hundred men, armed with your gun, would be equal, in point of efficacy, in battle, to one thousand armed with any other. Its superiority for hunting purposes is equally great, and cannot fail to secure for it the public favor.

The astonishing capability of your gun to resist dampness, or injury of its charge, when loaded, I consider of the greatest importance. A very striking and satisfactory instance of this manifested itself in the late battle with the Seminoles, on Lake Monroe. Your gun had at the time been loaded at least two weeks—had been taken out on one or more excursions, and exposed to the dampness of the atmosphere, which in that country is very great, and such other causes as had made it necessary to discharge and re-load all or most of the other arms similarly exposed,—yet, under these circumstances, without re-loading, yours went off in every instance, (the whole round of chambers,) as if recently charged. The simplicity of the machinery, and the great power with which it throws its balls, will justly enhance its estimation with all who will take the trouble to examine and make trial of them.

In conclusion, I will repeat, that I have no hesitation in giving it as my firm conviction that your's is by far the most efficient fire-arm ever offered to the public, and every way worthy of confidence and patronage.

I am, Sir, very respectfully,
Your most ob't. humble serv't.,
W. GORDON,
Captain U. S. Dragoons.
To Mr. JOHN COCHRAN, New-York.

CANAL NAVIGATION.—The annexed notice from the Philadelphia Gazette, of 21st March, shows the advantages possessed by Philadelphia for early navigation.

With a Railroad to *Olean*, on the Susquehannah River, New-York might send goods to Pittsburgh earlier than it is now done from Philadelphia.

IMPORTANT TO MERCHANTS.

We have been favored with the following information in relation to the opening of the Pennsylvania Canals and Railroads, which cannot fail to prove gratifying to that portion of the business community engaged in the Western Trade—coming as it does from head quarters.

CANAL ROOM, HARRISBURG,
March, 17, 1837.

C. G. CHILDS, Esq.

Dear Sir,—"On the Western Division they will commence letting water into the Canal on the 20th inst. The Portage Railroad is now in readiness, and in excellent order.—The Juniata Division is ready and filling.—The Susquehanna Division is in navigable condition, and the Eastern Divison is also ready and filling with water."

UNION CANAL.

Extract of a letter dated

LEBANON, March 18, 1837.

"Boatmen from the West, whose boats were left here last fall, have returned, and expect to leave here on the 21st inst. (Tuesday.) On Monday next they will commence loading some of the Lebanon boats."

The Schuylkill Canal will also be navigable on Wednesday. A very large amount of goods was carried to the different forwarding houses yesterday. This looks like going ahead.

The Delaware Division of the Pennsylvania Canal, from Bristol to Easton, we understand will be opened to-day. This will give an outlet to much Wheat, Flour, and other articles greatly wanted.

The following notice is taken from the Oswego Advertiser, of 13th March. It will be gratifying to business men to learn that the channels of transportation are so soon to be opened.

THE WELLAND CANAL.—We have been favored with the following information, by letter, (which was directed to all of our Forwarding Houses,) from officers of this Canal, re-affirming that it will be in readiness for navigation on the *15th of April*, which will be in season for the increased transit of merchandise and produce which this channel is likely hereafter to obtain.

WELLAND CANAL OFFICE,
ST. CATHARINES, 8th March, 1837.

MESSRS. TROWBRIDGE & GRANT—Gentlemen,—For your information I beg leave to annex a copy of the Engineer's letter, to the President, relating to, at what period the Canal may be in readiness for navigation this Spring.

I am respectfully, your ob't. ser't.,
JOHN CLARK, Secretary.

To W. H. MERRETT, Esquire, President W. C. Co.—Sir,—Unless some unforeseen accident occurs upon the Canal line, I think the navigation may be stated to commence upon the 15th day of April. This date will be as soon as Lake Erie is free of ice.

Your obedient servant,
FRANCIS HALL, Engineer.

Railroads appear to be advancing more rapidly in Germany than in France. That from Nuremberg to Furth transports weekly 18,000 travellers; that from Leipzic to Dresden will be opened immediately, and will join the Munich railroad at Augsburg, and in a few years will extend as far as Trieste. The subscription list for the railway from Magdebourg to Leipzic, the capital of which is fixed at 16,400,000fr. was filled in two days. A company is being formed for the establishment of a railroad between Hambourg, Berlin, and Magdebourg; it will extend 80 leagues, and will unite three towns with a population of five hundred thousand inhabitants, besides transporting an immense quantity of goods.

TRIUMPH OF RAILWAYS.—It was matter of some curiosity whether or not the engines could continue to work upon the Newcastle and Carlise railway during the continuance of the snow upon the road. The possibility of so working was fairly put to the test on the 26th ultimo, and the utility of railways demonstrated in a most striking manner.—In the deep cutting through the Cowan Hills, the snow had drifted to the depth of four or five feet; and when the Hercules came down on Monday morning, great number of country people had assembled to see how she would act in such an emergency, and to render any assistance which might be necessary. On arriving at the spot the engine made no bones of the matter, but dashed right into the drift, clearing its way through, apparently without the slightest difficulty, the snow at the same time flying over the top of the engine chimney like foam from the broken waves of a violent sea; and notwithstanding this and other similar obstructions, the train came down from Greenhead (twenty miles) in an hour and a quarter. The trains have continued regularly to keep their time, while all communication by common roads has been more or less most seriously obstructed if not entirely cut off for a time.—[Carliles Patriot.]

TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS.

ERECNT* CANAL-BOAT EXPERIMENTS.—DESCRIPTION AND TABULATED RESULTS OF A SERIES OF EXPERIMENTS MADE TO ASCERTAIN THE ACTUAL TRACTIVE POWER EXERTED IN DRAWING BOATS ON CANALS, UNDER VARIOUS CIRCUMSTANCES OF LOAD, SPEED, &c. BY JOHN MACNEILL, ESQ., M.I.C.E., F.R.A.S., M.R.I.A.

The series of Tables which I now have the honor of presenting to the Institution, have no merit beyond that of an honest and accurate Register of Facts. That the Experiments which they record were made neither to support nor to invalidate any theory, the following account of their origin will demonstrate.

The attention of the Committee of Management of the Forth and Clyde Canal Company, had frequently, in the course of their extensive and varied experience, been directed to some results, in the use of boats of different forms, on different canals, which appeared to contradict notions considered to be long established. The paradoxical character and important consequences of these results, at length determined the Committee, that a careful examination of the circumstances under which they had been observed should be made, and that upon a scale which should be free from the usual objections attending experiments made with models. I had the honor of receiving their commands to design and conduct this inquiry. In July, last year, I carried the examination into effect, with the boats, and on the canals, which had apparently presented the anomalous facts. The object aimed at, and which was supposed would satisfactorily settle every question, was to ascertain the tractive power exerted in drawing these boats on the canals in question, under very various circumstances of load, speed, &c. At least, one beneficial result seemed certain to be attained by the parties who had the spirit to undertake the inquiry, in consequence of their being interested in the navigation of

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* This term is preserved to distinguish these Experiments from others of the same kind, which Mr. Macneill had previously made on the Grand Junction Canal, &c.

the canals, viz.—it would determine which of the boats in use was best adapted for the purpose for which it was intended.

Though thus somewhat restricted by the very object of the inquiry, I cannot help hoping, that a vigilant attention to all the circumstances attending the numerous and varied experiments which would be necessary to solve the problem, and a faithful register of every influential fact, might add some authentic data to the very small stock, hitherto collected from actual experiment, on this most important and interesting, but intricate, subject of physical science.

It is in this way that, I conceive, the practical engineer may frequently assist the physico-mathematician, and enable the latter to investigate and reduce to simple laws many of those apparent anomalies which often puzzle, and sometimes disappoint, the former. As neither my professional engagements, nor my acquirements, will permit me in any case to attempt mathematical discussions of this high and important character, I have aimed at no other distinction than that of a careful observer, and a faithful reporter of facts. This is the utmost of my pretensions in the present Paper, and so far as this, I must acknowledge, I am ambitious to establish a claim.

Canals.—The canals on which the experiments, which it is the object of this Paper to record, were made, are, viz.—the Forth and Clyde Canal, the Monkland Canal, and the Paisley (*Glasgow and Paisley*) Canal. These were measured in several places. Sections made out from these measurements are given in Plate 28, and they show, that each canal differs very materially from either of the others. These peculiarties should constantly be borne in mind in comparing and reasoning upon the experiments.

Courses.—The portions of the canals selected for the sites of the experiments in Tables I.—X. were straight, and as nearly uniform in breadth and depth as could be obtained. These sites are designated, for distinction, the *courses.* On the Forth and Clyde Canal, there was no difficulty in the choice of a proper course of any desirable length. On the Monkland and on the Paisley Canals, no long line, free from objection, could be obtained; and, therefore, the courses on them were necessarily shorter.

Courses on the Forth and Clyde Canal.—Six stakes, marked *a, b, c, d, e, f,* were driven into the bank of the canal at intervals of 110 yards$=\frac{1}{16}$ of a mile. The first stake-interval *a-b* was used for getting the horses into the proper speed, and the boat into a uniform velocity, it is therefore not regarded in the Tables. The instants of the boat's passage of the stakes *b, c, d, e, f,* were accurately observed. These are given exactly as they stand in the minute-books of the recorders, in column C of the Tables. From these epochs the times of the passage of the boat through the stake-intervals, or *runs, b-c, c-d, d-e* and *e-f,* were obtained by simple substraction. These times are given in column E. The velocity in *miles per hour* and *feet per second* were then calculated from the preceding data, and the results are given in the columns F and H. In the experiment given in Table XII., the run extended about eight miles, but in this the tractive power only was observed.

Courses on the Monkland and Paisley Canals.—From reasons already stated, the courses on these canals were necessarily short. They had but three stake-intervals, and consequently only two runs. In every other respect they were the same as the course on the Forth and Clyde Canal. In the experiment given in Table XI., the run extended along the whole canal, and was about eight miles in length; but in this, as in the similar long run on the Forth and Clyde, the tractive power only was observed.

Boats.—All the boats had been, or were, in actual use on the canals in question, except one which had never been tried before, which is called "New Boat," to distinguish it. Plans, &c. of the most remarkable boats are given in Plate 27. Their weights will be found in column P of the Tables.

The loads and speeds of the boats were varied so as to include every case that had occurred, or was likely to occur, in practice. The speeds or velocities are given in columns F and H, and the loads in column J. The effects of the various loads, and of the different distributions of them, upon the draught of the boats, are given in columns L and M.

Instruments, and Manner of using them.—The *Dynamometer,** or instrument for ascertaining the tractive power exerted, was made a part of the connexion of the towing-line with the boat, so that all efforts to draw the boat by pulling the towing-line acted upon the instrument, and were indicated by it. Efforts from 1lb. up to nearly 600lbs. were clearly indicated on a large dial-plate, and could be satisfactorily read off.*

The times of the runs were observed with chronometers in the following manner:—An assistant was so placed on the outside of the boat, that he could accurately observe the moment of passing a stake. When this happened, he called out, and the instant was observed and registered by two assistants, each with a separate chronometer. These time-observers were found, on comparing their registers, never to have differed more than half a second from each other, and that in a very few instances only. The tractive power was obtained by three assistants: one gave a signal every two seconds; another, on this signal, read off aloud the figures at which the index pointed; and a third registered. By this arrangement all hurry and confusion were avoided; each assistant had ample time to do the work allotted to him; and it is believed, that few errors, and none of any magnitude, occurred in making or noting the observations. The numbers representing the tractive power were written down in columns, each column corresponding to a run, or stake-interval. The sum of a column divided by the number of observations, gave a number which was considered to be the mean tractive power in lbs. exerted during each run. These calculations were afterwards checked by two other persons.

In many of the experiments the level of a theodolite, steadily fixed in the boat, was observed under the following circumstances:—The boat, with its load distributed for the experiment, being at rest, the bubble was brought to the middle of the tube, and the index set at zero. The bubble being preserved in the same place during the experiment, the angle read off on the limb gave the angle of variation, which the keel of the boat made with its position before starting, or the difference, if any, between a state of rest and one of motion. Many of the angles observed are given in column O.

For the purpose of ascertaining if the boat was raised in the water, a fine wire was stretched across the canal, over two pullies placed in posts erected on the banks, by heavy weights attached to the end of it, so that it was very nearly level across the canal, and about eight inches higher than the boat. A bit of paper upon it marked the middle of the canal. On the top of the boat four slips of thin wood were placed,—one near the bow, one near the stern, and the other two at equal distances between them. These slips of wood were suspended vertically on fine wire pivots a little above their centre, so that they hung upright, except when they came in contact with the wire stretched across the canal; the moment they did so, they gave way, inclined backwards, and allowed the boat to pass freely under the wire: the edges of these slips were hollowed out, and the groove filled with tallow, projecting a little before the edge of the slip. The slips were divided into inches and tenths. When the boat was prepared and ready for an experiment, it was brought under the wire, and, being steadied near the paper-mark, the division cut by the wire on each slip was noted down. When the boat in motion passed under the same point, the wire struck the slips in succession, and stripped off all the tallow above a certain point with a sharp and clean cut, so that it was perfectly easy to determine the height to which the boat rose when in motion, by examining the slips, and comparing the divisions at which the tallow terminated with those previously noted.

* This instrument was similar to one I had previously designed and caused to be constructed, for ascertaining the amount of the draught of carriages drawn by horses on turnpike-roads. The principle is the same as that used in the spring-weighing machine, but the index of this instrument in its simple form, when applied to measure horse-draught, vibrates too frequently, and over too large an arc, for correct observation. This is a consequence of the peculiar nature of horse-draught, which is not a uniform pull, as is popularly supposed, but a succession of impulses or strokes of the animal's shoulder against the collar. I added an apparatus, which indicated the mean force of the pulls, and not only reduced the vibrations of the index, but, like the fusee of a watch, compensated for the increasing resistance of the spring in high efforts. A detailed description of this Road-Dynamometer, and its application on the whole length of road from London to Holyhead, is given in *the Seventh Report of the Parliamentary Commissioners for Maintaining the Road from London to Holyhead.* The instrument is also described in the *Further Report made by the Commissioners appointed to Inquire into the Post-Office Department, on the Subject of the Mail Coaches, dated 13th Aug.*, 1835. The instrument used on the canals was made from my designs, by Messrs. Bramah, of Pimlico, and was most carefully and beautifully finished.

Weather.—The weather was, almost without exception, extremely favorable for the purpose. The direction of the wind, its force, &c., are noted in column K.

Tables.—Such parts of the experiments as would admit of it, are classed together and tabulated to facilitate reference and comparison. Most of the columns have been described in the preceding paragraphs—the others require no explanation. The Tables I.—X. contain the experiments made on the courses. Tables XI. and XII. are the two eight-mile runs. In these the tractive power, indicated by the dynamometer, was read off as quick as it could be written down.

OBSERVATIONS.

1. That in the wide and deep canal, the tractive power was observed to increase with the velocity, but not in any uniform ratio.

2. That in the shallow and narrow canals, the increase of tractive power had a limit at a certain velocity; and, under certain circumstances, even decreased with the increase of velocity; so that it appears probable, that if the size of the canal bear a certain proportion to that of the boat, there is a certain velocity at which a boat may be drawn on a canal with a minimum tractive power. This velocity, on the Monkland and Paisley Canals, with boats like the Zephyr and the Swift, appears to be about nine miles per hour. And I think it probable that a similar effect would be observed on the Forth and Clyde Canal, if a boat similarly proportioned to that canal were used: though the velocity and the minimum tractive power in such a case might be different from those on the other canals.

3. That, in the long run on the Forth and Clyde Canal, the surface of the water regarded on the side of the boat, when in motion, was concave or hollow about the middle of the length of the boat, rising at the bow and quarter, as is shown by the line *a b c*, in Fig. 1.

4. That, in the long run on the Paisley Canal, precisely the opposite effect took place, the surface of the water about the middle of the length of the boat being convex, and higher there than at the bow and quarter, as *d e f*, in Fig. 2.

Fig. 1.

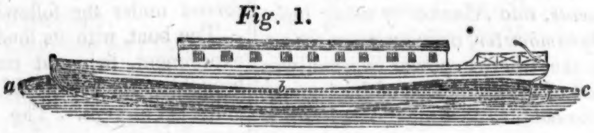
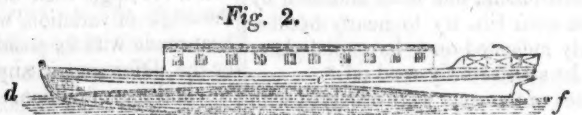


Fig. 2.



5. That there appears a relation between the tractive power and the horizontal position of the keel, the tractive power, it will be observed, diminishing and increasing in some ratio or other, as the angle of variation is smaller or larger.

6. That the boat absolutely rises during its motion. This fact was most satisfactorily demonstrated by the apparatus designed for the purpose. In some of the experiments, the mean of the several rises indicated by the four slips, was about four inches the bow being, in every case, more elevated than the middle and stern. As this phenomenon is of recent observation, and as the persons who have observed and announced it have been held up to unmerited ridicule, I beg leave to conclude with an extract from a paper read before the Philosophical Society of Cambridge, and published in their Transactions. The article is by one of the most profound physico-mathematicians in Great Britain, probably in the world, the Rev. James Challis, late Fellow of Trinity College,* Cambridge. The article is entitled, *Researches in the Theory of the Motion of Fluids.* Mr. Challis prefaces his Paper thus:—

"The subjects treated of in this communication are of a miscellaneous character, referring to several points of the theory of fluid motion, respecting which the author conceived he had something new to advance. In illustration of the principles he has attempted to establish, solutions are given of two problems of considerable interest:—the resistance to the motion of a ball-pendulum; and, the resistance of the motion of a body partly immersed in water and drawn along at the surface in the horizontal direction. The principal object in the solution of the latter problem is, to account for the rising of the body in the vertical direction on increasing the velocity of draught, which, in some recent experiments on Canal Navigation, has been observed to take place."

After an elaborate investigation of the law of this phenomenon, and showing that it must follow from the principles established by the Author in the preceding part of the Paper, he concludes by observing, that,

"To obtain a numerical result respecting the rise of the body corresponding to a given velocity, we will suppose, for the sake of simplicity of calculation, that when the vessel is at rest, the centres of the spherical ends, and consequently the axis of the cylindrical part, are in the plane of the horizontal surface of the water. This circumstance may be produced by *loading* the upper part of the body without altering its specific gravity. Let l = the length of the axis of the cylindrical portion; then the area of the horizontal section of the vessel, at the level the water surface, s of it $+ D \frac{\pi D^2}{4} - \frac{D_2}{2}$, its breadth being D. Now $W - w$ must be equal to the difference of the quantities of fluid displaced in the states of rest and motion, and is therefore equal to $\gamma g \left(lD + \frac{\pi D^2}{4} - \frac{D^2}{2}\right)$, γ being small.—Therefore neglecting powers of $\frac{\gamma}{a}$ above the first,

$$\left(lD + \frac{\pi D^2}{4} - \frac{D^2}{2}\right)\gamma g = \frac{V^2 D^2}{8}\left(2 - \frac{\pi}{4}\right).$$

Let $\frac{l}{D} = 3$. It will then be found that $V^2 = 696$ ft. $\times \gamma$. And if γ = one inch, or $\frac{1}{12}$, this equation gives $V = 5{\cdot}19$ miles per hour; consequently, if $V = 10{\cdot}4$ miles per hour, $\gamma = 4$ inches.

In general neglecting $\frac{\gamma^2}{a^2}$, &c.

$$W - w = \frac{V^2 a^2}{2}$$

$$\left(\sin\theta\cos\theta\,(2\sin^2\theta + 1) - \frac{\theta}{2}\right),$$

Also, $W - w =$

$$\gamma g \left\{ lD + \frac{D^2}{2\sin^2\theta}(\theta - \sin\theta\cos\theta) \right\}$$

nearly; therefore, as $D = 2a\sin\theta$, it will be found that

$$\gamma = \frac{V^2}{4g} \cdot \frac{\sin 2\theta\,(2\sin^2\theta + 1) - \theta}{4m\sin^2\theta - \sin 2\theta + 2\theta},$$ m being put for $\frac{l}{D}$.

If θ be assumed equal to 15°, and $m = 3$, this equation gives $V = 7{\cdot}35$ miles per hour when $\gamma = 4$ inches."

"These results, which probably are but very rough approximations to matters of fact, may yet suffice to show, that when vessels and boats of the usual forms sail in the open sea, they may be expected to rise in some degree upon an increase of their velocity, and so much the more as they are less adapted to *cleave* the water. Our theory shows that the rise is the same for bodies of the same shape and proportions, moving with the same velocity, whatever be their absolute magnitudes; also, that this effect is equally due to the pressures on the front and stern of the vessel. The theory, in fact, determines these pressures to be in every respect alike; so that if we proceeded to investigate the total pressure in the horizontal direction, we should find it to be nothing when the motion is uniform. This may serve to show, that, if friction be left out of consideration, a front ill adapted to cleave the water is not unfavorable to speedy motion, if the stern be of the same shape; and that the resistance to the motion of vessels in the open sea is principally owing to the friction of the water against their surface. This cause operates to produce unequal actions on the front and stern, making the directions of the motions of the particles in contact with the surface of the former *less* inclined to the horizon than they would be in the case of no friction, and of those in contact with the surface of the latter *more* inclined. To counteract this inequality, probably the stern should be less curved than the front." JOHN MACNEILL.

December, 1835.

* This gentleman has since succeded to the Plumian Professorship of Astronomy, in the University of Cambridge, vacant by the appointment of Professor Airy as Astronomer-royal.

TABLE I. THE RAPID (FIRST SET.—89 *Experiments*).

A No. of Experiment.	B Boat's name.	C Instant of passing the Stake.	D Stakes 100 yards apart.	E Time of passing the stake-interval.	F Miles per Hour.	G Tractive Power in lbs.	H Feet per Second.	I Kind of Tractive Power.	J Load.	K Wind.	L Draught. Bow.	M Draught. St'rn.	N Position of Wave.	O Variation in Level.	P REMARKS. PLACE OF EXPERIMENT, FORTH AND CLYDE CANAL.
		m. s.		sec.	miles.	lbs.	feet.								
1	RAPID.	56 58 58 05 59 09 14 1 16	b c d e f	 67 63½ 65½ 62	 3·33 3·54 3·46 3·63	 33 39 38·5 37·1	 4·89 5·20 5·08 5·32	One Horse.	7 passengers, = c. 9 q. 2 lb. 1	unf. light	in. 12¼	in. 9	not obs.	not obs.	Weight of RAPID, when empty, 3 ton, 8 cwt. 2 qr. 20lb. Towing-line, 116 ft. long, attached 4½ft. from bow, and passed through two pulleys—Load distributed from bow to stern.
2	RAPID.	5 53 7 03 8 17 9 20 10 22	b c d e f	 60 64 63 62	 3·75 3·52 3·57 3·63	 30 25 31·3 30·4	 5·50 5·16 5·24 5·32	do.	do.	fav. do.	do.	do.	do.	do.	
3	RAPID.	22 21 24 03 25 45 27 25½ 28 59	b c d e f	 102 102 100½ 84½	 2·21 2·21 2·24 2·38	 24 23·5 23·5 23·5	 3·24 3·24 3·28 3·49	One Man.	6 passengers, = c. 8 q. 0 lb. 15	unf.	not obs.	not obs.	do.	do.	
4	RAPID.	33 54 35 28 36 57 38 27 40 00	b c d e f	 94 89 90 93	 2·39 2·53 2·50 2·42	 19·4 18·25 18 18	 3·51 3·71 3·67 3·55	do.	do.	fav.	do.	do.	do.	do.	
5	RAPID.	50 03 51 13½ 52 24½ 58 37 54 51	b c d e f	 70½ 71 72½ 74	 3·19 3·17 3·10 3·04	 33·1 28·3 28 27·8	 4·68 4·65 4·55 4·46	do.	do.	unf.	do.	do.	do.	do.	
6	RAPID.	20 1 29½ 2 38½ 3 46 4 57	b c d e f	 69½ 68½ 68 71	 3·24 3·29 3·31 3·17	 26·8 24·8 24·1 23	 4·75 4·82 4·85 4·65	do.	7 passengers, = c. 9 q. 2 lb. 1	fav.	in 12¼	in. 9	do.	do.	
7	RAPID.	23 14 23 55 24 37 25 14½ 25 50½	b c d e f	 41 42 37½ 36	 5·49 5·36 6·00 6·25	 76·1 64·5 98·7 99·7	 8·05 7·86 8·80 9·17	One Horse.	9 passengers, = c. 12 q. 0 lb. 25	unf.	not obs.	not obs.	do.	do.	Bad experiment from irregular draught.
8	RAPID.	35 08½ 35 46 36 23 37 00 33 38	b c d e f	 38½ 37 37 38	 5·84 6·08 6·08 5·92	 95 97 89 84	 8 57 8·92 8·92 8·68	do.	7 passengers, = c. 9 q. 2 lb. 1	fav.	in. 12¼	in. 9	do.	do.	
9	RAPID.	43 30 44 05 44 40 45 15 45 51	b c d e f	 35 35 35 36	 6·43 6·43 6·43 6·25	 104·4 105 104 99·6	 9·43 9·43 9·43 9·17	One Horse.	7 passengers, and 10 cwt. = c. 19 q. 2 lb. 1	fav.	in. 11¼	in. 11¼	not obs.	not obs.	
10	RAPID.	51 25 52 00½ 52 34 53 09 53 44	b c d e f	 35 34½ 34½ 35	 6·43 6·52 6·52 6·43	 131 121 118 110·9	 9·43 9·57 9 57 9·43	Two Horses.	do.	do.	do.	do.	do.	do.	
11	RAPID.	2 10½ 2 36 2 57½ 3 19 3 40½	b c d e f	 25½ 21½ 21½ 21½	 8 82 10·47 10·47 10·47	 261 302 299 286	 12·94 15 35 15·35 15·35	do.	do.	do.	do.	do.	do.	do.	
12	RAPID.	10 53 11 16 11½ 37 11 59 12 21	b c d e f	 23 21½ 21½ 22	 9·78 10·47 10·47 10 23	 294 293 297 278	 14·35 15·35 15·35 15·00	do.	do.	do.	do.	do.	do.	do.	

TABLE I. CONTINUED.—THE RAPID (FIRST SET).

13	RAPID.	19 51½	*b*					Two Horses.	7 passengers, and 4½ ton, = *c. q. lb.* 94 2 1	fav.	12½ in.	in. $12\frac{2}{1}$	not obs.	not obs.	
		20 13	*c*	21½	10·47	316	15·35								
		20 33½	*d*	20½	10·91	300	16·09								
		20 54½	*e*	21	10·71	306·8	15·71								
		21 17	*f*	22	9·98	290·1	14·67								
14	RAPID.	25 55½	*b*					do.	do.	do.	do.	do.	do.	do.	
		26 17	*c*	21½	10·47	298	15·35								
		26 38	*d*	21	10·71	290	15·71								
		26 59½	*e*	21½	10·47	295	15·35								
		27 21	*f*	21½	10·47	290	15·35								
15	RAPID.	39 00½	*b*					do.	do.	do.	do.	do.	do.	do.	
		39 45½	*c*	45	5·00	73	7·33								
		40 31½	*d*	46	4·89	71	7·17								
		41 16½	*e*	45	5·00	78·7	7·33								
		42 00	*f*	43½	5 17	72·5	7·59								
16	RAPID.	49 13½	*b*					do.	do.	do.	do.	do.	do.	do,	
		50 06	*c*	52½	4·29	54·0	6·29								
		50 54½	*d*	48½	4·64	61·9	6·80								
		51 41	*e*	46½	4·84	62·9	7·10								
		52 26	*f*	45	5·00	70·3	7·33								
17	RAPID.	19 28	*b*					do.	7 passengers, and 1 ton, = *c. q. lb.* 29 2 1	do.	12¼	12¼	do.	do.	Heavy Rain.
		20 15	*c*	47	4·79	68	7·02								
		21 03	*d*	48	4·69	56	6·88								
		21 52	*e*	49	4·59	60·2	6·73								
		22 42½	*f*	50½	4·46	55·7	6·53								
18	RAPID.	29 18	*b*					Two Horses.	7 passengers, and 1 ton, = *c. q. lb.* 29 2 1	fav.	in. 12¼	in. 12¼	not obs.	not obs.	
		30 04½	*c*	46½	4·84	68	7·10								
		30 52	*d*	48½	4·64	63·9	6·80								
		31 39	*e*	47	4·79	68·8	7·02								
		32 30½	*f*	50½	4·46	52·2	6·53								
19	RAPID.	40 45½	*b*					do.	do.	light	do.	do.	do.	do.	
		41 09	*c*	23½	9·57	308	14·04								
		41 30½	*d*	21½	10·47	308	15·35								
		41 52	*e*	21½	10·47	310	15·35								
		42 13½	*f*	21½	10·47	300	15·35								
20	RAPID.	7 15	*b*					do.	do.	do.	do.	do.	do.	do.	
		7 38	*c*	23	9·78	292	14·35								
		8 00	*d*	22	10·23	289	15·00								
		8 22	*e*	22	10·23	292	15·00								
		8 43	*f*	21	10·71	296	15·71								
21	RAPID.	14 11	*b*					do.	7 passengers, and 4½ ton = *c. q. lb.* 94 2 1	none	17	17	do.	do.	Tractive power doubtful. See Remark, Experiment, No. 44.
		14 39	*c*	28	8·03	312	11·79								
		15 08	*d*	29	7·76	327	11·38								
		15 37	*e*	29	7·76	350?	11·38								
		16 06½	*f*	29½	7·59	356?	11·19								
22	RAPID.	23 22½	*b*					do.	do.	do.	do.	do.	do.	do.	
		23 49½	*c*	27	8·33	325	12·22								
		24 17½	*d*	28	8·03	332	11·79								
		24 46	*e*	29	7·76	342	11·38								
		25 14½	*f*	28½	7·90	344	11·58								
23	RAPID.	32 19	*b*					do.	do.	do.	do.	do.	do.	do.	Bad experiment. Horses going irregularly.
		33 08	*c*	49	4·59	59·6	6·73								
		33 50	*d*	42	5·36	118	7·86								
		34 35	*e*	45	5·00	61·8	7·33								
		35 23½	*f*	48½	4·64	69·8	6·80								
24	RAPID.	41 32½	*b*					do.	do.	do.	do.	do.	do.	do.	
		42 24½	*c*	52	4·33	74	6·35								
		43 16	*d*	51½	4·37	52	6·41								
		44 07	*e*	51	4·41	57	6·47								
		44 55	*f*	48	4·69	70	6·88								
25	RAPID.	42 55½	*b*					do.	do.	do.	do.	do.	do.	do.	Bad experiment. Boy off horse. Tractive power doubtful. See Remark, Experiment, No. 44.
		43 23½	*c*	28	8·03	355?	11·79								
		43 52	*d*	29½	7·59	356?	11·19								
		44 21½	*e*	29½	7·59	360?	11·19								
		44 51	*f*	29½	7·59	363?	11·19								
26	RAPID.	3 11½	*b*					do.	do.	do.	do.	do.	do.	do.	do.
		3 34	*c*	22½	10·00	360?	14·67								
		3 58	*d*	24	9·48	348	13·75								
		4 21	*e*	23	9·78	351?	14·35								
		4 44	*f*	23	9·78	353?	14·35								

TABLE I. continued.—THE RAPID (First Set).

27	Rapid.	13 23	*b*	23·	9·78	374?	14·35	Two Horses.	7 passengers, and 4½ ton, = *c. q. lb.* 94 2 1	none	in. 17	in. 17	not. obs.	not. obs.	Tractive Power doubtful. See Remark, Experiment, No. 44.
		13 46	*c*	23½	9·57	369?	14·04								
		14 09½	*d*	25	9·00	366?	13·20								
		14 34½	*e*	27	8·33	365?	12·22								
		15 01½	*f*												
28	Rapid.	27 51	*b*	23½	9·57	364?	14·04	do.	do.	do.	do.	do.	do.	do.	do.
		28 14½	*c*	25	9·00	345?	13·20								
		28 39½	*d*	26½	8·49	354?	12·45								
		29 06	*e*	28½	7·90	355?	11·58								
		29 34½	*f*												
29	Rapid.	56 50½	*b*	26	8·65	354?	12·69	do.	do.	do.	do.	do.	do.	do.	do.
		57 16½	*c*	26	8·65	356?	12·69								
		57 42	*d*	28½	7·90	363?	11·58								
		58 10½	*e*	28	8·03	366·4	11 79								
		58 38½	*f*												
30	Rapid.	6 19½	*b*	28½	7·90	316	11·58	do.	do.	unf. light	do.	do.	do.	do.	
		6 48	*c*	29½	7·59	324	11·19								
		7 17½	*d*	28½	7·90	340	11·58								
		7 46	*e*	28½	7·90	341	11·58								
		8 14½	*f*												
31	Rapid.	23 31	*b*	87	2·59	31	3·79	One Man.	do.	fav. light	do.	do.	do.	do.	
		24 58	*c*	75½	2·98	34	4·37								
		26 13½	*d*	78½	2·57	30	3·77								
		27 41	*e*	79	2·85	30	4·18								
		29 00	*f*												
32	Rapid.	37 09	*b*	87	2·59	27	3·79	do.	do.	do.	do.	do.	do.	do.	
		38 36	*c*	88	2·56	25	3·75								
		40 04	*d*	88	2·56	26	3·75								
		41 32	*e*	88	2 56	25	3·75								
		43 00	*f*												
33	Rapid.		*b*					Two Horses.	7 passengers, and 3½ ton, = *c. q. lb.* 79 2 1	do.	16	16	do.	do.	Tractive Power doubtful. See Remark, Experiment, No. 44.
		13 21	*c*	22	10·23	354?	15·00								
		13 43	*d*	22	10·23	351?	15·00								
		14 05	*e*												
			f												
34	Rapid.	19 59	*b*	23½	9·57	358?	14·04	do.	6 passengers, and 3½ ton = *c. q. lb.* 78 0 15	do.	not obs.	not obs.	do.	do.	do.
		20 22½	*c*	22½	10·00	353?	14·67								
		20 45	*d*	24½	9·18	334	13·47								
		21 09½	*e*	23½	9·57	334	14·04								
		21 33	*f*												
35	Rapid.	31 27½	*b*	27½	8·18	328	12·00	do.	7 passengers, and 3½ ton, = *c. q. lb.* 79 2 1	do.	16	16	do.	do.	do.
		31 55	*c*	27½	8·18	337	12·00								
		32 22½	*d*	28½	7·90	351?	11·58								
		32 51	*e*	28	8·03	367?	11·79								
		33 19	*f*												
36	Rapid.	38 14	*b*	27	8·33	326	12·22	Two Horses.	7 passengers, and 3½ ton, = *c. q. lb.* 79 2 1	fav. light	in. 16	in. 16	not obs.	not obs.	
		38 41	*c*	28½	7·90	333	11·58								
		39 09½	*d*	28½	7·90	341	11·58								
		39 37	*e*	29	7·76	348	11·38								
		40 06	*f*												
37	Rapid.	46 01	*b*	29½	7·59	238	11·19	do.	do.	do.	do.	do.	do.	do.	
		46 30½	*c*	29	7·76	249	11·38								
		47 00½	*d*	32	7·03	245	10·31								
		47 32½	*e*	31	7·26	238	20·65								
		48 03½	*f*												
38	Rapid.	55 41	*b*	31½	7·14	274	10·48	do.	do.	unf. light	do.	do.	do.	do.	Heavy rain.
		56 12½	*c*	31½	7·14	247	10·48								
		56 44	*d*	31	7·26	256	10·65								
		57 15	*e*	31	7·26	243	10·65								
		57 46	*f*												
39	Rapid.	7 03	*b*	48½	4·64	65	6·80	do.	do.	fav. light	do.	do.	do.	do.	Light rain.
		7 51½	*c*	50½	4·46	67	6·53								
		8 42	*d*	53	4·25	59	6·23								
		9 35	*e*	53	4·25	62	6·23								
		10 28	*f*												
40	Rapid.	17 21	*b*	66	3·41	46·4	5·00	do.	do.	none	do.	do.	do.	do.	
		18 27	*c*	68	3·31	44	4·85								
		19 35	*d*	66	3·41	45	5·09								
		20 41	*e*	64	3·52	46	5·16								
		21 45	*f*												

TABLE 1. CONTINUED.—THE RAPID (FIRST SET).

41	RAPID.	15 31½ 15 55½ 16 18 16 39½ 17 01	b c d e f	24 22½ 21½ 21½	9·38 10 00 10·47 10·47	366? 376? 376? ·75?	13·75 14·67 15·35 15·35	Two Horses.	7 passengers, and 3½ ton, = c. q. lb. 79 2 1	fav. light	in. 16	in. 16	not obs	not obs.	Tractive power doubtful. See Remark, Experiment, No. 44. Boat grazed.
42	RAPID.	22 57 23 23½ 23 48 24 13½ 24 39½	b c d e f	25½ 24½ 25½ 26	8·82 9·18 8·82 8·65	335 357? 367? 365?	12·94 13·47 12·94 12·69	do.	do.	unf. strng. brze.	do.	do.	do.	do.	Tractive power doubtful. See Remark, Experiment, No. 44.
43	RAPID.	28 32 29 00 29 30 29 59 30 28	b c d e f	28 30 29 29	8·03 7·50 7·76 7·76	337 328 337 338	11·79 11·00 11·38 11·38	do.	do.	fav.	do.	do.	do.	do.	Observed that the piston of the dynamometer had not range enough, therefore all preceding experiments in which the tractive power exceeds 350 lb., are doubtful.
44	RAPID.	39 32½ 40 02½ 40 33 41 03½ 41 33½	b c d e f	30 30½ 30½ 30	7·50 7·38 7·38 7·50	317 314 316 307	11·00 10·82 10·82 11·00	do.	do.	unf.	do.	do.	do.	do.	Gave sufficient range to the piston.
45	RAPID.	49 28½ 49 57 50 26½ 51 11 51 38	b c d e f	29½ 29½ 27	7·59 7·59 8·33	316 324	11·19 11·19 12·22	Two Horses.	7 passengers, and 3½ ton, = c. q lb. 79 2 1	fav.	in. 16	in. 16	not obs.	not obs.	Bad Experiment. Horse broke loose.
46	RAPID.	56 56 57 28 57 57½ 58 29 50 59½	b c d e f	32 29½ 32½ 30½	7·03 7·59 6 91 7·38	274 278 279 291	10·31 11·19 10·15 10·82	do.	do.	unf.	do.	do.	do.	do.	
47	RAPID.	2 42 3 03½ 3 24 3 44 4 05½	b c d e f	21½ 20½ 20 20½	10·47 10·93 11·25 10·93	497 498 486 469	15·35 16·09 16·50 16·09	do.	do.	fav.	do.	do.	do.	do.	
48	RAPID.	12 35 12 58 13 20 13 42½ 14 04½	b c d e f	23 22 22½ 22	9·78 10·23 10·00 10·23	466 426 416 417	14·35 15·00 14·67 15·00	do.	do.	unf.	do.	do.	do.	do.	
49	RAPID.	39 37½ 40 01½ 40 24 40 46 41 08½	b c d e f	24 22½ 22 22½	9·38 10·00 10·23 10·00	437 451 428 427	13·75 14·67 15 00 14·67	do.	7 passengers, and 4¼ ton, = c. q lb. 94 2 1	fav.	16	17	do.	do.	
50	RAPID.	46 53 47 17½ 47 42 48 06½ 48 32½	b c d e f	24½ 24½ 24½ 26	9·18 9·18 9·18 8·65	435 433 426 428	13·47 13·47 13·47 12·69	do.	do.	unf.	do.	do.	do.	do.	
51	RAPID.	8 25 8 53 9 22½ 9 52½ 10 22½	b c d e f	28 29½ 30 30	8·03 7·59 7·50 7·50	343 344 350 332	11·79 11·19 11·00 11·00	do.	do.	fav. light	do.	do.	do.	do.	Warm sunshine.
52	RAPID.	16 16 16 47 17 18 17 47½ 18 18½	b c d e f	31 31 28½ 31	7·26 7·26 7·90 7·27	291 286 309 304 5	10·65 10·65 11·58 10·65	do.	do.	unf.	do.	do.	do.	do.	
53	RAPID.	21 22 21 53 22 25 22 54½ 23 25½	b c d e f	31 32 29½ 29	7·26 7·03 7·59 7·76	321 305 326 310	10·65 10·31 11·19 11·38	do.	do.	fav.	do.	do.	do.	do.	
54	RAPID.	35 07 35 40 36 12 26 42 37 14	b c d e f	33 32 30 32	6·82 7·03 7·50 7·03	269 237 273 286	10·00 10·31 11·00 10·31	Two Horses.	7 passengers, and 4¼ ton, = c. q. lb. 94 2 1	fav. light	in. 17	in. 17	not obs.	not obs.	

TABLE 1. CONTINUED.—THE RAPID (FIRST SET).

55	RAPID.	43 37 44 29 45 20$\frac{1}{2}$ 46 12 47 02	b c d e f	52 51$\frac{1}{2}$ 51$\frac{1}{2}$ 50	4·33 4·37 4·37 4·50	66 60 67 62	6·35 6·41 6·41 6·60	One Horse. Boy leading	7 passengers, and $4\frac{1}{4}$ tons,= c. q. lb. 84 2 1	fav. light	in. 17	in. 17	not obs.	not obs.	
56	RAPID.	58 49 59 55 1 00$\frac{1}{2}$ 2 07 3 10	b c d e f	66 64$\frac{1}{2}$ 66$\frac{1}{2}$ 63	3·41 3·49 3·38 3·57	54 49 46 56	5·00 5·12 4·96 5·24	do.	do.	do.	do.	do.	do.	do.	
57	RAPID.	9 37 9 59$\frac{1}{2}$ 10 22$\frac{1}{2}$ 10 45 11 07	b c d e f	22$\frac{0}{2}$ 23 22$\frac{1}{2}$ 22$\frac{1}{2}$	10·00 9·70 10·08 10·00	487 457 446 421	14·67 14·35 14·67 14·67	Two Horses.	do.	av. very light	do.	do.	do.	do.	
58	RAPID.	16 04 16 27$\frac{1}{2}$ 16 51$\frac{1}{2}$ 17 16$\frac{1}{2}$ 17 43	b c d e f	23$\frac{1}{2}$ 24 25 26$\frac{1}{2}$	9·57 9·38 9·00 8·49	445 419 421 417	14·04 13·75 13·20 12·45	do.	do.	unf. very light	do.	do.	do.	do.	
59	RAPID.	37 46$\frac{1}{2}$ 38 14 38 41$\frac{1}{2}$ 39 10 39 39	b c d e f	27$\frac{1}{2}$ 26$\frac{1}{2}$ 28$\frac{1}{2}$ 29	8·18 8·49 7·90 7·76	391 383 405 402	12·00 12·45 11·58 11.38	do.	do.	do.	19$\frac{1}{2}$	15$\frac{1}{2}$	do.	do.	Weight shifted forward.
60	RAPID.	44 28 44 55 45 25 45 54 46 23$\frac{1}{2}$	b c d e f	27 30 29 29$\frac{1}{2}$	8·33 7·50 7·76 7·59	388 404 416 409	12 22 11·00 11·38 11·19	do.	do.	do. light	do.	do.	do.	do.	
61	RAPID.	9 34 10 02 10 31 11 00 11 29$\frac{1}{2}$	b c d e f	28 29 29 29$\frac{1}{2}$	8·03 7·76 7·76 7·59	412 410 437 430	11·79 11·38 11·38 11·19	do.	do.	fav. very light	do.	do.	do.	do.	
62	RAPID.	16 37$\frac{1}{2}$ 17 06 17 36 18 05$\frac{1}{2}$ 18 35$\frac{1}{2}$	b c d e f	28$\frac{1}{2}$ 30 29$\frac{0}{1}$ 30	7·90 7·50 7·59 7·50	356 364 378·9 353	11·58 11·00 11·19 11·00	do.	do.	unf. very light	do.	do.	do.	do.	
63	RAPID.	33 02 33 30 33 59 34 27$\frac{1}{2}$ 34 56	b c d e f	28 29 28$\frac{1}{2}$ 28$\frac{1}{2}$	8·03 7·76 7·90 7·90	403 384 419 430	11·79 11·39 11·58 11·58	Two Horses.	7 passengers, and $4\frac{1}{4}$ tons,= c. q. lb. 94 2 1	unf. very light	in 19$\frac{1}{2}$	in 15$\frac{1}{2}$	not obs.	not obs.	Towing-line attached 5$\frac{1}{2}$ ft. from bow.
64	RAPID.	49 41 50 10$\frac{1}{2}$ 50 40 51 10$\frac{1}{2}$ 51 40	b c d e f	29$\frac{1}{2}$ 29$\frac{1}{2}$ 30$\frac{1}{2}$ 29$\frac{1}{2}$	7·59 7·59 7·38 7·59	386·8 413 414·6 428	11·19 11·10 10·82 11·19	do.	do.	do.	do.	do.	do.	do.	Towing-line taken through one pully only, and 4 ft. 1 in. from the bow.
65	RAPID.	28 54 29 21 29 49 30 18 30 46$\frac{1}{2}$	b c d e f	27 28 29 28$\frac{1}{2}$	8·33 8·03 7·76 7·90	316 323 360·6 367 8	12·22 11·79 11 38 11·58	do.	do.	do.	do.	do.	do.	do.	Outrigger used 6 ft. 4 in. from the gunwale, and 5 ft. from the bow.
66	RAPID.	42 51 53 21 43 50$\frac{1}{2}$ 44 20 44 50$\frac{1}{2}$	b c d e f	30 29$\frac{1}{2}$ 29$\frac{1}{0}$ 30$\frac{1}{2}$	7·50 7·59 7·59 7·38	295·6 292·3 315·2 301·4	11·00 11·19 11·19 10·82	do.	do.	do.	do.	do.	do.	do.	No outrigger.
67	RAPID.	18 31 19 01 19 32 20 02 20 33	b c d e f	30 31. 30 31	7·50 7·26 7 50 7·26	303 272·5 281 261	11·00 10·65 11·00 10·65	do.	do.	do.	do.	do.	do.	do.	Outrigger, 3 feet 8 in. from gunwale, 5 ft. 6 in. from bow.
68	RAPID.	31 55 32 21$\frac{1}{2}$ 32 48 33 17 33 45	b c d e f	26$\frac{1}{2}$ 26$\frac{1}{2}$ 29 28	8·49 8·49 7·76 8·03	366 378 382·6 419	12·45 12·45 11·38 11·79	do.	do.	do.	do.	do.	do.	do.	

TABLE I. CONTINUED.—THE RAPID (FIRST SET).

69	RAPID.	53 20	b					Two Horses.	7 passengers, and 4¼ tons = c. q. lb. 94 2 1	fav. light	in. 19½	in. 15½	not obs.	not obs.	Towing-line from the bow.
		53 48	c	28	8·03	468	11·79								
		54 17	d	29	7·76	438·5	11·38								
		54 45	e	28	8·03	473·5	11·79								
		54 13½	f	28	7·90	477·7	11·58								
70	RAPID.	18	b					do.	7 passengers, and 3 ton, = c. q. lb. 69 2 1	none	15⅜	15⅜	do.	do.	A barge passed at 1 m. 12s.
		44½	c	26½	8·49	328·4	12·45								
		1 13½	d	29	7·76	314·2	11·38								
		1 41	e	27½	8·18	386·4	12·00								
		2 09	f	28	8·03	365	11·79								
71	RAPID.	8 10	b					do.	do.	unf. light	do.	do.	do.	do.	
		8 37	c	27½	8·18	326·6	12·00								
		9 05½	d	28½	7·90	351·1	11·58								
		9 33	e	27½	8·18	362·6	12·00								
		10 01½	f	27½	8·18	364·7	12·00								
72	RAPID.	13 54½	b					Two Horses.	7 passengers, and 3 ton, = c. q. ld. 69 2 1	unf. light	in. 15⅜	in. 15⅜	do.	do.	
		14 21	c	26½	8·49	337	12·45								
		14 48	d	27	8·33	339	12·22								
		15 16	e	28	8·03	358	11·79								
		15 44	f	28	8·03	365	11·79								
73	RAPID.	26 03	b					do.	do.	do.	do.	do.	do.	do.	
		27 11	c	28	8·03	289·3	11·79								
		27 39	d	28	8·03	301·5	11·79								
		28 07½	e	28½	7·90	318·3	11 58								
		29 36½	f	29	7·76	312·4	11·38								
74	RAPID.	57 51	b					do.	do.	do.	do.	do.	do.	do.	
		58 18	c	27	8·33	335·7	12·22								
		58 46	d	28	8·03	335·5	11·79								
		59 15	e	29	7·76	351·4	11·38								
		59 43	f	28	8·03	382·6	11·79								
75	RAPID.	10 19	b					do.	do.	do.	do.	do.	do.	do.	
		10 43	c	24	9·38	396·3	13·75								
		11 09	d	26	8·65	363	12·69								
		11 34	e	25	9·00	406·4	13·20								
		11 59	f	25	9·00	410	13·20								
76	RAPID.	25 29	b					do.	do.	do.	do.	do.	do.	do.	
		25 55½	c	26½	8·49	386·5	12·45								
		26 22	d	26½	8·49	384·5	12·45								
		26 50	e	28	8·03	393·5	11·79								
		27 18	f	28	8·03	405·5	11·79								

VII. ON THE EFFECTIVE POWER OF THE HIGH-PRESSURE EXPANSIVE CONDENSING STEAM ENGINES COMMONLY IN USE IN CORNISH MINES. BY MR. T. WICKSTEED, CIVIL ENGINEER. COMMUNICATED IN A LETTER TO THE PRESIDENT.

Particulars of the Cornish engines, showing that they are not inapplicable for water-works purposes:—

First—The steam is raised to about 40 lbs. pressure upon the square inch, and the admission of it into the cylinder is cut off when the piston has travelled one-third, one fourth, one-eighth, or even one-tenth of the length of the stroke, according to the work to be done, and during the remainder of the stroke the expansive power of the steam is exerted.

Second—The boilers are tubular, in some instances having an internal tube, *b b*, and a feed tube, *c c*, as represented in the accompanying drawing; in other instances these tubes are not introduced. I consider their introduction an improvement; the quantity of surface of the boiler exposed to the action of the fire, or heat of the flues, in proportion to its cubic contents of water, as compared with the Boulton and Watt boiler, is as 60 to 37, or as 3 to 2 nearly.

Third—All those parts of the boilers, cylinder, and pipes containing steam which are exposed to the air in most engines, are in the Cornish engines completely cased with a non-conducting material, which, in fact, renders the engine and boiler houses, where this system is carried to its full extent, as cool as the inside of a dwelling-house where there are only ordinary fires Very little heat is lost when the engine stands still for twelve hours, and if it is necessary to start it during the night, or in case of emergency, scarcely any time is lost in raising the steam, and one-fourth the fuel only is required after the engine has been standing all night; whereas, in the common engines and boilers, where every vessel containing steam is much exposed, it takes from twenty minutes to half an hour, firing hard, to raise the steam.

Fourth—The steam and exhausting valves are (what are termed in the county) "double beat valves;" they may be said to combine the advantages of the circular and slide valves, although not constructed like either; the effect is, however, that a man, who would not have strength to raise the valves of a 36 inch cylinder made according to the ordinary construction, may with perfect ease work the valves of an 80 inch cylinder, as made in Cornwall; the exhausting valves and the pipes leading to the condenser are made of much greater area than ordinarily.

Fifth—The length of the stroke is greater, and the number of strokes per minute fewer, than in other engines.

Sixth—The water is raised by a solid plunger working through a stuffing box, instead of a packed piston or bucket, so that, the packing being external, any leakage is detected immediately, without the delay attendant upon examining and fresh packing the ordinary packed pistons; and the pump may thus be made always to do its full duty, instead of, as is frequently the case, the water escaping by the piston when the packing becomes imperfect, or through bad valves when a bucket is used, and which cannot be detected until it increases to such an extent that the irregular working of the engine denotes it.

Seventh—The valves of the pump, instead of having their hinges in the centre, obliging the water to pass through a confined space between the valve and the side of the valve box, and lying almost flat upon their seats, making it necessary for them to rise much higher than would otherwise be required to deliver the quantity of water, and causing upon its descent so forcible a blow as to render it necessary to admit air under the valves, partially destroying the vacuum in preference to shaking the engine to pieces, and with openings through them of one-half or two-thirds the area of the pump barrel, rendering

much greater power requisite to overcome the friction of the water in its passage through them,—instead of this arrangement, the valves are hung at the circumference of the circle and open in the centre, and the lower ones are fixed directly under the pump barrel;—they lie at a considerable angle to the horizon, so that a less rise of the valves is sufficient for the passage of the water, and the openings are made *equal* in area to the pump barrel. The effect is, that, without the admission of air, as is absolutely necessary in the ordinary pumping engines, and which diminishes the quantity of water raised per stroke, although working under more than three times greater column of water, they make no blow of any consequence upon the return stroke.

Eighth—The cataract is used, by which the engine may be made to work from 1 to 12 strokes per minute, as may be required, consuming coals nearly in proportion to the number of strokes; the best rate however is about 5 or 6 strokes per minute. The cataract is peculiarly applicable to engines used in draining mines, where the work to be done increases in proportion as the working of the mine progresses: and also to engines for water-works where the demand increases every year, and the power must increase in proportion. To illustrate this, when one of the London water-works was first established, there were two engines of 30 horses' power, afterwards one of 20 horses' power, and afterwards one of 80 horses' power erected; the number of engines increasing as the demand for increased supply. Now if an engine upon the Cornish plan had been erected, which at 8 strokes per minute had been equal to 160 horses' power, then by working it 3 strokes per minute it would have been equivalent to the two 30 horse engines only, at 4 strokes to the two 30 horse and the 20 horse engines, and at 8 strokes equal to all of them. In this case one engine would have answered the purpose, and the saving that would have been made in engines, boilers, buildings, &c., wear and tear of machinery, labor, and current expenses, is evident.

Ninth—As the extent of pipes in a water works district increases, the amount of friction must also increase, and the engine must work under a greater pressure; there must consequently be a greater load upon the pump. The ordinary engines would not be able to work under this increased load, and a smaller pump must be used; but as this would not give a sufficient quantity of water a new engine must be erected, and this has been the case hitherto; whereas, in a Cornish engine, by increasing the pressure of steam, or by working a less proportion of the stroke by the expansive force of the steam, this increase of expense may be much longer deferred.

Tenth—The Cornish engines, in which the before named arrangements have been adopted, do about three times more work, with the same quantity of fuel, than the common water-works pumping engines. As this has, however, been declared impossible, I will endeavor to prove the contrary by a comparison of the two engines.

The common water-works engine is worked with steam at a pressure generally of two and a half or three pounds above the pressure of the atmosphere; the admission of steam is not cut off until the piston has made three-fourths or seven-eighths of its stroke, and the principle object in view in cutting it off at all is to make the danger of the piston travelling too far, and the chance of breaking the bottom of the cylinder, beam, or parallel motion, less.

On the 18th of February last, I tried the power of an engine upon this construction; the experiment lasted one hour, and 469 lbs. of good Holywell Main large coals were used. The diameter of the cylinder was 60 inches, length of stroke 7 feet 9 inches; the engine made 869 strokes in the hour, or 14.48 strokes per minute; the pressure of steam was $2\frac{1}{2}$ lbs. per square inch above the pressure of the atmosphere, which was $14\frac{3}{4}$ lbs.; the vacuum in the condenser equal to $13\frac{1}{4}$ lbs.; the diameter of the pump was 27 inches, the length of the stroke 7 feet 9 inches, the pressure upon the pump piston equal to a column of water of 115 feet in height, load upon pump piston 28,577 lbs., equal to 10.1 lbs pressure per square inch of the steam piston; as the pressure of the steam, minus $1\frac{1}{2}$ lb. for imperfect vacuum in the condenser, was $15\frac{3}{4}$ lbs., the friction of the engine must have amounted to 5.65 lbs. per square inch.

The steam used in the hour may be found thus:—the area of cylinder was 19.63 square feet, and the steam was cut off at 1 foot 3 inches from the end of stroke, making length of the stroke for the dense steam 6 feet 6 inches, which, multiplied by the area, gives 127.6 cubic feet per stroke, add $\frac{1}{10}$ for loss of steam per stroke in the vacancies of the cylinder, making a total of about 140 cubic feet of steam per stroke, which, multiplied by the number of strokes per hour, (869 × 140,) is equal to 121,640 cubic feet of steam, generated under a pressure of 35.2 inches of mercury, at a temperature of about 222° Fahrenheit.

The "duty" p.rformed was 34,467,052 lbs. raised 1 foot high with a bushel, or 84 lbs. of coals.

The power of the engine during the time of trial was $(\underset{\text{lbs. load.}}{28{,}577} \times \underset{\text{stroke.}}{7.75} + \underset{\text{strokes per min.:}}{14.48} \times 33{,}000)$ equal to 97.2 horses' power.

The steam used was equal to 1251 cubic feet per hour per horses' power, to produce which, at a temperature of 222° Fahrenheit, would require about 0.856 cubic foot of water, and to convert this quantity of water into steam at 222°, it *required*, 4.82 lbs. of coals.

Now supposing the admission of steam was cut off when the piston had travelled one-sixth of its stroke, the operation of its expansion, and the pressure at different stages, and mean pressure of the whole, will be seen by the following Table.

	lbs. pressure per square inch.
During $\frac{1}{6}$th of the stroke dense steam was admitted at a pressure of	17.25
At $\frac{2}{6}$ of the stroke the steam had expanded to twice its volume, and the pressure was reduced to	8.62
At $\frac{3}{6}$ ditto ditto three times	5.75
At $\frac{4}{6}$ ditto ditto four times	4.31
At $\frac{5}{6}$ ditto ditto five times	3.45
At $\frac{6}{6}$ ditto ditto six times	2.87
	6)42.25
Mean pressure per square inch	7.04 lbs.

If the steam had worked dense throughout, the pressure would have been 17.25 lbs. throughout, but 6 times the quantity of steam would have been required; whereas, with one-sixth the quantity of steam, the mean pressure is 7.04 lbs. per square inch, showing that as the quantity of fuel required is in proportion to the steam generated, by working the engine thus expansively the effect is as 2.4 to 1.

If, however, the steam was to be generated under no higher pressure than 17.25 lbs. per square inch, it would be necessary to have the area of the steam cylinder 2.4 times greater than the one hereinbefore mentioned, to raise the load; that is to say, a cylinder of nearly 93 inches in diameter, with 7.04 lbs. pressure per square inch, instead of a cylinder 60 inches with $17\frac{1}{4}$ lbs. pressure per square inch. As this would obviously be disadvantageous, inasmuch as there would be a great increase of friction, the practice of using steam of higher temperature, say from 35 lbs. to 40 lbs. above the pressure of the atmosphere, has been adopted in Cornwall. In fact, the general dimensions for a Cornish engine to do the work hereinbefore stated, would probably have been as follows, viz.

Diameter of cylinder	57 inches.
Length of stroke	10 feet.
Number of strokes per minute	7
Diameter of pump piston	34 inches.
Length of stroke	10 inches.
Load on pump piston	45.805 lbs.
Load per square inch on steam piston	18 lbs.

In addition to the foregoing, which only shows the advantage to be 2.4 instead of 3, as I have before stated it to be, there is a very considerable saving in fuel in consequence of the casing, which saving is of course greater in proportion in engines where steam of a high temperature is used; and there is also less friction, in consequence of the slow motion of the engine, and from the other causes already stated, which, in my opinion, are fully equal to make up the difference. It is hardly necessary to observe here, that the more the steam is worked expansively the greater is the proportional advantage.

The principle of expansion is not *new*; it is the extent to which it has been carried, especially of late years, by the successful adoption of steam at a higher temperature than is used in the common condensing engine, which is new.

The late Mr. Watt took out a patent in 1782 for working steam expansively, and in his specification, dated March 12th, 1788, he says, "My new improvement in steam or fire engines, consists in admitting steam into the cylinder of the engine only

during some certain part or portion of the descent or ascent of the piston, and using the elastic forces where with the said steam expands itself in proceeding to occupy larger spaces as the acting powers on the piston, through the other parts or portions of the length of the stroke of the piston."

He then shows, that if steam of 14 lbs. pressure is admitted into a cylinder, and cut off at one-fourth of the length of the stroke, that at half the stroke the pressure is reduced to 7 lbs.; at three-fourths of the stroke to 4⅔ lbs.; and at the end of the stroke the steam would be reduced to 3½ lbs., or one-fourth of its original power. He then shows that the sum of all these powers is greater than 57-hundredth part of the original power multiplied by the length of the stroke, and consequently, that one-fourth the steam, thus used, produces more than half the effect that four times the quantity would have produced if worked dense through the whole stroke.

He then says, "consequently, the said new or expansive engine is capable of easily raising columns of water, whose weights are equal to 5 lbs. on every square inch of the area of its piston, by the expenditure of only one-fourth the contents of the cylinder of steam at each stroke."

He had previously shown that the engine working dense steam might be loaded to 10 lbs. per square inch of the area of the piston.

And lastly, he says, "and though, for example, I have mentioned the admission of one-fourth of the cylinders full of steam, as being the most convenient, yet any other proportion of the content of the cylinder will produce similar effects, and in practice I actually do vary the proportions as the case requires."

The casing of the cylinders, boilers, and steam-pipes is not new either, but I have never seen it carried to the same extent as it is at present in Cornwall.

Great and deserved credit is due to the perseverance, energy, and ingenuity of the Cornish engineers for bringing the expansive engine to the state that it now is, and for the daily improvements which, although taken separately may appear trivial, are in the aggregate of great importance.

I will conclude this portion of my observations by referring you to the printed Report of the public trial to which the Fowey Consols engine before mentioned has been exposed, in which it is stated, that the engine raised above 125 millions of lbs. one foot high, with 94 lbs. of coals, or nearly 112 millions with 84 lbs., or an imperial bushel. This is the greatest performance of any engine; and the engineers, Messrs. Petherick and West, cannot fail to receive the credit they so richly merit.

Although it is admitted by some engineers in London, that the reports from Cornwall may be true, and that water may be raised out of the *mines* at the expense of power reported, nevertheless, they assert that it is not applicable to water works purposes, on account of the variation in the pressure.

That there is a variation in the pressure where the water is forced into the pipes directly from the engine is certain, and it must be dependent upon the quantity of water drawn from the mains by the tenants, and as this varies, so the pressure must vary—the variation is either not very great, or is periodical; thus the pressure during the day is greater than at night, and during summer greater than in winter. In either case, the increased pressure arises from the circumstance of a greater quantity of water having to be forced through the same pipes in a given time; consequently, the velocity must be greater, and as a matter of course the friction, which increase of friction must be overcome by increased power. If the only variation was a periodical one, and at each period the pressure was steady, then reservoirs at different altitudes, to suit the different pressures, would supply the district as well as a steam engine; (even this position has been disputed;) but as at every stroke of the engine there is a slight variation, not amounting, however, during any of the periods before named to more than 5 or 6 feet, then, as the mean difference is 2½ feet, and in case of a reservoir it would be necessary to have its altitude equal to the greatest pressure, there would be a loss amounting to the difference between the mean and the greatest altitude. It should be observed, that the *greatest* portion of the metropolis supply is from summit reservoirs.

Supposing that a Cornish engine could not be worked in the same manner as a London water-works engine, which, however, is not the case, and that it were necessary to work it under a fixed pressure, varying, however, at *given* periods, the loss, as before shown, is trifling. Suppose it to be 2½ per cent.; or taking the variation at 20 feet, instead of 5 feet, the loss would then be 10 per cent.; the gain, however, by adopting the Cornish engine, is 300 per cent.

There would, however, be an advantage in working either a Cornish or a London pumping engine under a fixed pressure instead of a variable one, and much less danger; for in all single engines, working under a pressure that varies, and where from the great extent of mains and services there is great liability to accident from the bursting of pipes, or sudden shutting off an important main by accident or design, the danger of the piston travelling too far, and thereby breaking the beam, or the cylinder bottom, is very great, and the only safeguard is the vigilance of the engine-keeper, who, if he is constantly watching, may take the engine "in hand," in case of a sudden variation in its speed, and thus prevent the accident which might otherwise have disabled the engine. This is not by any means a hypothetical case.

It would therefore be the safest plan to work the engine under a fixed load, even at the loss of a little power, if at the same time the liability to accident was rendered infinitely less.

In most cases, therefore, where the pressure under which the engine works is known, *and it ought to be known*, I should recommend the adoption of a standpipe, the water rising from the engine in one pipe, and flowing over either at the top, or through communicating pipes, at any level required, into the descending pipe communicating with the mains in the district. The engine might then work under a regular load; any fracture of the pipes in the district would not affect the engine; its only liability to accident being from the fracture of one leg of the standpipe, which of course could be provided against by extra strength of materials.

Although I have shown how (upon the supposition of the variation in pressure being an objection to the application of the Cornish engine to water-works purposes) the supposed difficulty may be overcome, I by no means intend to allow that the engines in Cornwall are not subject to chances of as great and even greater variation; for if any valve breaks, which is very likely to happen where there are so many pumps at work, if the water at any time fails, and air is suddenly admitted through the suction-pipes, &c., &c., in all such cases, the resistance to the power of the engine is reduced, and if the parts of the engine were not made strong enough to resist the force of a sudden blow, fracture would take place; but they are generally, and ought always, to be strong enough.

In conclusion, I beg to observe, that if the Cornish engines do the work that it is stated they do, and if they are applicable to water-works purposes, of both of which I have no doubt, then the saving is most important; for supposing instead of *three* engines, consuming 3000 tons of coals per annum, *one* could be erected doing the work of the three, and only consuming 1000 tons, assuming the price of coals delivered to be 18s. per ton, the saving in coals alone, without reference to the savings in the reduced number of engine-keepers and stokers, the current expenses of one engine instead of three, the wear and tear of machinery and buildings, would be £1800 per annum.

Nov. 4, 1835.

M. Degousse has succeeded in piercing a fourth Artesian Well, at Meaux. The depths of the bores of these wells are from 164 to 295 feet English, and the water rises to from 3¼ feet to 16 feet 4 inches English. The quantity obtained at the Fulling Mills is 66 English gallons a minute, and that at the Seminary 37 gallons. The water is very soft, and has been proved by an analysis to be fit for every purpose.

RAILROAD AND CANAL STOCKS, in New-York and Philadelphia.

SALES OF STOCK IN NEW-YORK

March, 30th.

Mohawk Railroad	cash	70
Paterson Railroad	"	65
Boston and Providence	"	95
New-Jersey Trans.	"	92¼
Stonington	"	69
Worcester Railroad	"	91
Long Island Railroad	"	64
Paterson Railroad	"	65
Stonington Railroad	"	55
Harlaem Railroad		64
Utica and Schenectady	cash	114
Delaware and Hudson Canal	"	73¼
Morris Canal	"	79
New Orleans Canal	"	95

PHILADELPHIA STOCK MARKET.

March 24th.

	Price of shares	Offered	Asked
RAILROAD STOCKS			
New-Castle and Frenchtown	25	29	30
Do loan, 5½ per cent	100	99	101
Wilmington and Susquehanna	50	33	36
Camden and Amboy, shares,	100	130	136
Do loan, 6's 1836	100	110	120
Danville and P shares	50	25	35
Norristown, do	50	27	29
Do 6 per cent loan	100	85	100
Valley Railroad	7½	1	3
Westchester do	50	20	28
Minehill do	50	57	59
N. L. and Penn. Tp. do	40	34½	35
Philadelphia and Trenton do	100	121	123
West Philadelphia Railroad	50	20	30
Harrisburg and Lancaster	50	46	48
Cumberland	25	15	20
Beaver Meadow	50	57	57½
MISCELLANEOUS STOCKS			
North American Coal Company	25	12	14
Steam Bt. Sts. Columbian	100	18	22
Exchange Stock	100	70	80
Arcade	100	55	75
Theatres—Chestnut street	600	625	675
———Walnut street	280	175	220
———Arch street	500	325	375
Gas Company	100	100	102
CANAL STOCKS			
Schuylkill Navigation, shares	50	155	158
Do loans, 5 1845	100	98	100
Do do 1855	100	100	101
Do do 5½ 1837	100	98	100
Lehigh Coal and Navigation	50	72	75
Do loan, 6 1833	100	97	98
Do do 6 1839	100	97	9[illegible]
Do do 6 1844	100	99	100
Do do 5 1840	100	96	97½
Union Canal, shares	200	180	190
Do loan, 1836	100	83	86
Do do 1840	100	85	90
Chesap'k & Delaware Canal, shares	200	20	40
Do loan, 1837	100	60	67
Do do 1840	100	60	67
Delaware and Hudson,	100	70	70½
Do loan	100	95	100
Louisville and Portland	100	112½	117
Convertible 6 per cent. loans,	100	110	120
Sandy and Bever	100	60	80
Morris Canal	100	81	83

LIST OF SUBSCRIBERS to the **Railroad Journal,** that have paid, (continued.)

Witherell Ames, and Co., city, to January 1, 1838
C. F Howell, city, Jan. 1, 1838
Adam Hall, " Jan. 1, 1838
J. Aikins, Paulins, N. Y. Jan. 1, 1838
W. H. Talcott, Albany, " Jan. 1, 1838
H. Burden, Troy, " Jan. 1, 1838
" Advertising " " Jan. 1, 1838
E. C. Scott, Newburgh " Oct. 1, 1837
J. B. Sargent, " " Jan. 1, 1838
H. & S. Parmlee Little Falls N. Y. January 1, 1838
C. Minor, Wilksbarre, Pa., Jan. 1, 1838
Mr. Sheaf, Downington, " In Full
James Seymour, Chicago, Ill. March 15, 1838
W. S. Wait, Greenville, Ill., Jan. 1, 1838
James Blake, Indiannapolis, Indiana, January, 1, 1838
J. Desshler, Tuscumbia, Alabama, January 1, 1838
Engineer and General Superintendent of T. D & C. R. R. Co., January 1, 1838
President of T. D & C R. R. Co., January 1. 1838
J. P. Kirkwood, Jamaica, L. I. Jan. 1, 1838
Col. H. Long, Hopkington, N. H. January 1, 1838

Advertisements.

☞ MISSING NUMBERS WANTED.—If any of our subscribers have numbers 4, 5, 6 and 7, of Volume or *five last* year, which they do not desire to preserve, they will confer a special favor by sending them to us, that we may complete a few copies of the volume.

*** If any of our subscribers are in want of *any other* number of the same volume to complete their volume they will please give early notice and they shall be sent.

The Title page and Index for last year, or volume five, will be forwarded to subscribers with our next number.

TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS OF GREAT BRITAIN.

The first volume of this valuable work, has just made its appearance in this country. A few copies, say *twenty-five* or *thirty only*, have been sent out, and those have nearly or quite all been disposed of at *ten dollars* each—a price, although *not* the *value* of the work, yet one, which will prevent many of our young Engineers from possessing it. In order therefore, to place it within their reach, and at a convenient price, we shall *reprint* the entire work, with all its engravings, *neatly done* on wood, and issue in six *parts* or *numbers*, of about 48 pages each, which can be sent to any part of the United States by mail, as issued, or put up in a volume at the close.

The price will be to subscribers *three dollars*, or *five dollars* for two copies—*always in advance*. The first number will be ready for delivery early in April—Subscriptions are solicited.

ARCHIMEDES WORKS.

(100 North Moor street, N. Y.)

NEW-YORK, February 12th, 1836.

THE undersigned begs leave to inform the proprietors of Railroads that they are prepared to furnish all kinds of Machinery for Railroads, Locomotive Engines of any size, Car Wheels, such as are now in successful operation on the Camden and Amboy Railroad, none of which have failed—Castings of all kinds, Wheels, Axles, and Boxes, furnished at shortest notice

4—ytf H. R. DUNHAM & CO.

NEW ARRANGEMENT.

ROPES FOR INCLINED PLANES OF RAILROADS.

WE the subscribers having formed a co-partnership under the style and firm of Folger & Coleman, for the manufacturing and selling of Ropes for inclined planes of railroads, and for other uses, offer to supply ropes for inclined planes, of any length required without splice, at short notice, the manufacturing of cordage, heretofore carried on by S. S. Durfee & Co., will be done by the new firm, the same superintendant and machinery are employed by the new firm that were employed by S. S. Durfee & Co. All orders will be promptly attended to, and ropes will be shipped to any port in the United States.

12th month, 12th, 1836. Hudson, Columbia County State of New-York.

ROBT. C. FOLGER,
33—tf. GEORGE COLEMAN,

MACHINE WORKS OF ROGERS, KETCHUM AND GROSVENOR, Paterson, New Jersey.

The undersigned receive orders for the following articles, manufactured by them, of the most superior description in every particular. Their works being extensive, and the number of hands employed being large, they are enabled to execute both large and small orders with promptness and despatch.

RAILROAD WORK.

Locomotive Steam-Engines and Tenders; Driving and other Locomotive Wheels, Axles, Springs and Flange Tires; Car Wheels of cast iron, from a variety of patterns, and Chills; Car Wheels of cast iron, with wrought Tires; Axles of best American refined iron; Springs; Boxes and Bolts for Cars.

COTTON, WOOL AND FLAX MACHINERY,

Of all descriptions and of the most improved Patterns, Style, and Workmanship.

Mill Geering and Millwright work generally; Hydraulic and other Presses; Press Screws; Callenders; Lathes and Tools of all kinds; Iron and Brass Castings of all descriptions.

ROGERS, KETCHUM & GROSVENOR
Patterson, New-Jersey, or 60 Wall street, N. Y
51tf

ALBANY EAGLE AIR FURNACE AND MACHINE SHOP.

WILLIAM V. MANY manufactures to order, IRON CASTINGS for Gearing Mills and Factories of every description.

ALSO—Steam Engines and Railroad Castings of every description.

The collection of Patterns for Machinery, is not equalled in the United States. 9—1y

TO ENGINEERS.

WE are gratified to be able to announce to those desiring INSTRUMENTS, that Messrs E. & G. W. BLUNT of this city, are now prepared to furnish at short notice, LEVELS, from different manufacturers, among others from Troughton & Sims, which they warrant of the first quality. Circumferentors, Levelling Staves, Prismatic Compasses, Mathematical Instruments, Books for Engineers, etc constantly on hand.

One of the above firm is now in England superintending the manufacture of Theodolites, Transit Instruments, etc—and any orders for Instruments, now on hand, will be forwarded him, and executed promptly.

_ Orders will be received and promptly attended to by the Editors of this Journal. 9 4t

AN ELEGANT STEAM ENGINE AND BOILERS, FOR SALE.

THE Steam Engine and Boilers, belonging to the STEAMBOAT HELEN, and now in the Novelty yard, N. Y. Consisting of one Horizontal high pressure Engine, (but may be made to condense with little additional expense) 36 inches diameter, 10 feet stroke, with latest improved Piston Valves, and Metalic packing throughout.

Also, four Tubular Boilers, constructed on the English Locomotive plan, containing a fire surface of over 600 feet in each, or 2500 feet in all—will be sold cheap. All communications addressed (post paid) to the subscriber, will meet with due attention.

HENRY BURDEN.

Troy Iron Works, Nov. 15, 1836. 4—tf

TO MANUFACTURERS OF HYDRAULIC CEMENT.

PROPOSALS will be received by the subscriber, on the part of the James River and Kanawka Companies, for the delivery on the wharf, at the city of Richmond, Va., of Fifty Thousand Bushels of Hydraulic Cement. The amount called for must be furnished in quantities of about six thousand, bushels per month, commencing on the first of April and ending on the first of November next.

To avoid future litigation, it is to be understood, on making the proposals, that the bushel shall weigh seventy pounds NETT, and that the Cement shall be delivered in good ordder, and packed in tight casks or barrels.

Proposals will also be received for furnishing fifty thousand bushels, at any convenient point on the navigable waters of James River, or the north branch of James River, where the materials for its manufacture has been discovered.

Persons familiar with the preparation of the Cement, would do well to examine the Counties of Rockbridge and Botetourt, with a view to the establishment of works for the supply of the western end of the line; and a contract for the above quantities will be made with them before they commence operations.

As there will be required on the line of the James River and Kanawka Improvement, in the course of the present and next year, not less than half a million of bushels of this Cement, and some hundred thousand bushels more in the progress of the work towards the west, contractors will find it to their interest to furnish the article on terms that lead to future engagements.

Proposals to be directed to the subscriber at Richmond, Va. CHARLES ELLET, Jr.,
Chief Engineer of the J. R. and Ka. Co.
February 20th, 1837. 9 6t

CROTON AQUEDUCT.

NOTICE.—Sealed Proposals will be received by the Water Commissioners of the city of New-York, until the 22d day of April next, at 3 o'clock, P. M., at their office in the city of New-York, and until the 24th day of April, at 9 o'clock, P. M., at the office of their Engineer in the village of Sing Sing, for constructing a Dam across the Croton River, for the Excavation, Embankment, Back Filling, Foundation and Protection Walls; for an Aqueduct Bridge at Sing Sing, three Tunnels, several large and small culverts, and an Aqueduct of stone and brick masonry, with other incidental work, for that portion of the Croton Aqueduct which extends from the Dam on the Croton to Sing Sing, being between eight and nine miles in length

The prices for the work must include the expense of materials necessary for the completion of the same, according to the plans and specifications that will be presented for examination, as hereinafter mentioned.

The Work to be completed by the first day of October, 1839.

Security will be required for the performance of contracts—and propositions should be accompanied by the names of responsible persons, signifying their assent to become sureties. If the character and responsibilities of those proposing, and the sureties they shall offer, are not known to the Commissioners or Engineers, a certificate of good character, and the extent of their responsibility, signed by the first judge or clerk of the county in which they severally reside, will be required.

No transfer of contracts will be recognised.

Plans of the several structures and specifications of the kind of materials and manner of construction, may be examined at the office of the Commissioners, in the city of New-York, from the 10th to the 14th, inclusive, of April next. The line of Aqueduct will be located, and the map and profile of the same, together with the plans and specifications above mentioned, will be ready for examination at the office of the Engineer, at the village of Sing Sing, on the 15th day of April next, and the Chief or Resident Engineer will be in attendance to explain the plans, &c., and to furnish blank propositions.

Persons proposing for more work than they wish to contract for, must specify the quantity they desire to take

The full names of all persons that are parties to any proposition, must be written out in the signature for the same.

The parties to the propositions which may be accepted, will be required to enter into contracts immediately after the acceptance of the same.

The undersigned reserve to themselves the right to accept or reject proposals that may be offered for the whole or any part of the above described work, as they may consider the public interest to require.

STEPHEN ALLEN,
CHARLES DUSENBURY, } Water
SAUL ALLEY, } Commissioners.
WILLIAM W. FOX,
JOHN B. JERVIS,
Chief Engineer, New-York Water Works.
New-York, February 28, 1837. 10 5t

AMES' CELEBRATED SHOVELS, SPADES, &c.

300 dozens Ames' superior back-strap Shovels
150 do do do plain do
150 do do do caststeel Shovels & Spades
150 do do Gold-mining Shovels
100 do do plated Spades
50 do do socket Shovels and Spades.

Together with Pick Axes, Churn Drills, and Crow Bars (steel pointed,) manufactured from Salisbury refined iron—for sale by the manufacturing agents,

WITHERELL, AMES & CO.
No. 2 Liberty street, New-York.
BACKUS, AMES & CO.
No. 8 State street, Albany.

N. B.—Also furnished to order, Shapes of every description, made from Salsbury refined Iron v4—tf

STEPHENSON,

Builder of a superior style of Passenger Cars for Railroads.

No. 264 Elizabeth street, near Bleecker street, New-York.

RAILROAD COMPANIES would do well to examine these Cars; a specimen of which may be seen on that part of the New-York and Harlaem Railroad now in operation J25tf

PATENT RAILROAD, SHIP AND BOAT SPIKES.

_ The Troy Iron and Nail Factory keeps constantly for sale a very extensive assortment of Wrought Spikes and Nails, from 3 to 10 inches, manufactured by the subscriber's Patent Machinery, which after five years successful operation, and now almost universal use in the United States, (as well as England, where the subscriber obtained a patent,) are found superior to any ever offered in market.

Railroad Companies may be supplied with Spikes having countersink heads suitable to the holes in iron rails, to any amount and on short notice. Almost all the Railroads now in progress in the United States are fastened with Spikes made at the above named factory—for which purpose they are found invaluable, as their adhesion is more than double any common spikes made by the hammer.

_ All orders directed to the Agent, Troy, N. Y., will be punctually attended to.

HENRY BURDEN, Agent.

Troy, N. Y., July, 1831.

_ Spikes are kept for sale, at factory prices, by I. & J. Townsend, Albany, and the principal Iron Merchants in Albany and Troy; J. I. Brower, 222 Water street, New-York; A. M. Jones, Philadelphia; T. Janviers, Baltimore; Degrand & Smith, Boston.

P. S.—Railroad Companies would do well to forward their orders as early as practicable, as the subscriber is desirous of extending the manufacturing so as to keep pace with the daily increasing demand for his Spikes. (1J23am) H. BURDEN.

FRAME BRIDGES.

THE undersigned, General Agent of Col. S. H. LONG, to build Bridges, or vend the right to others to build, on his Patent Plan, would respectfully inform Railroad and Bridge Corporations, that he is prepared to make contracts to build, and furnish all materials for superstructures of the kind, in any part of the United States, (Maryland excepted.)

Bridges on the above plan are to be seen at the following localities, viz. On the main road leading from Baltimore to Washington, two miles from the former place. Across the Metawamkeag river on the Military road, in Maine. On the national road in Illinois, at sundry points. On the Baltimore and Susquehanna Railroad at three points. On the Hudson and Patterson Railroad, in two places. On the Boston and Worcester Railroad, at several points. On the Boston and Providence Railroad, at sundry points. Across the Contoocook river at Henniker, N. H. Across the Souhegan river, at Milford, N. H. Across the Connecticut river, at Haverhill, N. H. Across the Contoocook river, at Hancock, N. H. Across the Androscoggin river, at Turner Centre, Maine. Across the Kennebec river, at Waterville, Maine. Across the Genesse river, at Squakiehill, Mount Morris, New-York. Across the White River, at Hartford Vt. Across the Connecticut River, at Lebanon, N. H. Across the mouth of the Broken Straw Creek, Penn. Across the mouth of the Cataraugus Creek, N. Y. A Railroad Bridge diagonally across the Erie, Canal, in the City of Rochester, N. Y. A Railroad Bridge at Upper Still Water, Orono, Maine. This Bridge is 500 feet in length; one of the spans is over 200 feet. It is probably the FIRMEST WOODEN BRIDGE ever built in America.

Notwithstanding his present engagements to build between twenty and thirty Railroad Bridges, and several common bridges, several of which are now in progress of construction, the subscriber will promptly attend to business of the kind to much greater extent and on liberal terms. MOSES LONG.

Rochester, Jan. 13th, 1837. 4—y